Gertsch

PRELIMINARY INSTRUCTION BOOK FOR RS SERIES RESOLVER STANDARDS

ELECTRONIC INSTRUMENTS

PRELIMINARY

INSTRUCTION BOOK

FOR

RS SERIES

RESOLVER STANDARDS

GERTSCH PRODUCTS, INC.,
LOS ANGELES 16, CALIFORNIA

March 13, 1962

WARRANTY POLICY

Gertsch Products, Inc. guarantees any equipment which we manufacture to meet the advertised performance specifications applying to that particular equipment.

Gertsch Products, Inc. warrants each instrument of its manufacture to be free from defects in material and workmanship. Our obligation under this Warranty is limited to servicing or adjusting any instrument returned to our factory for that purpose, and to making good at our factory any part or parts thereof except tubes, transistors, diodes, fuses, batteries or RatioTran potentiometers which shall, within one year after making delivery to the original purchaser, be returned to us with transportation charges prepaid, and which on our examination shall disclose to our satisfaction to have been thus defective.

Gertsch Products, Inc. reserves the right to make changes in design at any time without incurring any obligation to install same on units previously purchased.

This Warranty is expressly in lieu of all other obligations or liabilities on the part of Gertsch Products, Inc., and Gertsch Products, Inc. neither assumes nor authorizes any other person to assume for them any other liability in connection with the sales of Gertsch Products, Inc. instruments.

This Warranty applies only to the original purchaser unless approval for resale is obtained in writing from Gertsch Products, Inc.

Equipment ----------

Serial No. ----------

Sold to ----------

Date Sold ----------

GERTSCH PRODUCTS, INC.
3211 South La Cienega Boulevard
Los Angeles 16, California

CONTENTS

		PAGE
SECTION I	GENERAL DESCRIPTION	3
SECTION II	CIRCUIT DESCRIPTION	5
SECTION III	OPERATION	8
SECTION IV	CALIBRATION AND MAINTENANCE	9

SECTION I

GENERAL DESCRIPTION

Gertsch Resolver Standards are precision transformer instruments, esigned to simulate the "ideal" electrical outputs (±2 seconds with no load) f a Resolver Control Transmitter (RX). When driven by a suitable* signal ource the Resolver Standard generates, in precise angular increments normally 5°), two isolated voltages proportional to the sine and cosine of the ngle displayed on the dial. Quadrant switching is provided to simulate peration over a full 360°.

Because of their inherently low output impedance and very low output mpedance unbalance, Resolver Standards may be operated under normal oad, with very little degradation of accuracy.

Resolver Standards are generally used to transmit precise angular lata to Resolver Differential Transformers (RD's) and Resolver Control Transformers (RC's). Most commercially available resolvers of this type nay be excited from a Resolver Standard without appreciably affecting the no-load accuracy.

* Low distortion

Model Number and Type			Rotor Input Voltage Ein	Max. Stator Output Voltage E_s (max)	Maximum Effective Output Impedance Unbalance at 400 cps
2 Switch	1 Switch	Stepper Switch			
RS-1R	RS-4R	RS-7R	26V	11.8V	(.01+j.001) ohms/SIN 2 θ
RS-2R	RS-5R	RS-8R	115V	90V	(.05+j.005) ohms/SIN 2 θ
RS-2AR	RS-5AR	RS-8AR	115V	11.8/90/115V	(.05+j.005) ohms/SIN 2 θ
RS-2BR	RS-5BR	RS-8BR	115V	115V	(.05+j.005) ohms/SIN 2 θ

) Frequency Range: 400 - 1600 cps

) Angular Accuracy (no load): ±2 seconds-of-arc

) Transformation Ratio, $N = \frac{E_s \text{ (Max)}}{E_{in}}$: ±.1% maximum

) Transformation Ratio Deviation (Δ N) From Nominal, As a Function of Angle: ±1% maximum

) Angular Range: 0-360°, continuous

) Angular Increments: 5°

) Size (Rack Mounted) : 19-1/2" x 3-1/2" x 12-1/4"D (Stepper Switch Models, 14"D)

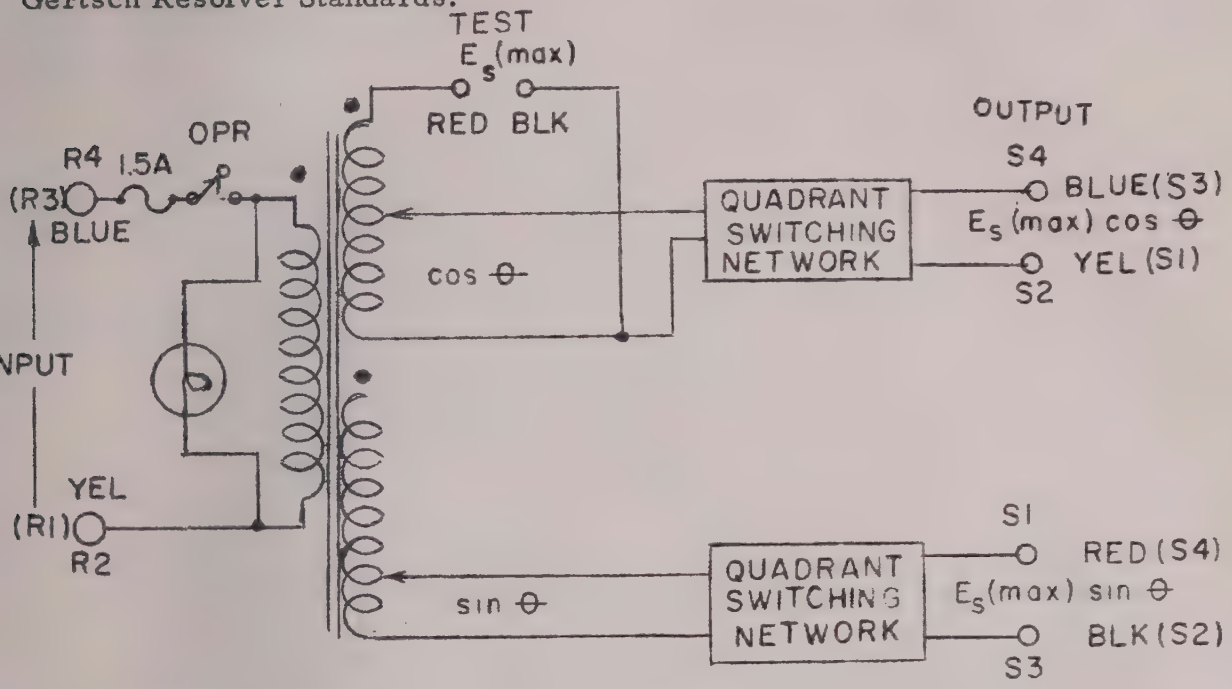
NBS TRACEABILITY

A certificate is available, on request, showing accuracy measured in terms of a standard which has been certified by the National Bureau of Standards in Washington, D. C.
(NBS Calibration Test 1.3/160058)

SECTION II

CIRCUIT DESCRIPTION

The following figure illustrates the basic circuitry common to all Gertsch Resolver Standards:



Operational versatility of the Resolver Standard is increased by the use of two sets of terminal identifications. The input identification (R2-R4 or R1-R3) selected, determines the output identification markings to be used by the operator. The binding posts are color coded per Mil-R-21530C, for the terminal identifications not parenthetically enclosed (R2-R4 excitation).

The phase relationships of the output voltages relative to the input voltage, conform to Mil-R-21530C for both sets of terminal identifications. That is:

$$E_{S1-S3} = N(E_{R1-R3} \cos \theta - E_{R2-R4} \sin \theta)$$

$$E_{S2-S4} = N(E_{R2-R4} \cos \theta + E_{R1-R3} \sin \theta)$$

where N is the transformation ratio of the Resolver Standard, and θ is positive for CCW rotation from electrical zero (EZ), when viewed from the shaft end.

The equivalent angular position of a Resolver Standard is uniquely and completely defined as a function of the ratio of the output voltages to each other:

$$E_{S3\text{-}S1} = NE_{R2\text{-}R4} \sin \theta$$

$$E_{S2\text{-}S4} = NE_{R2\text{-}R4} \cos \theta$$

Therefore, ideally:

$$A = \tan \theta,$$

$$\text{where } A = \frac{E_{S3\text{-}S1}}{E_{S2\text{-}S4}}$$

The relationship between a deviation in ratio and an equivalent angular error is derived by differentiating the above equation with respect to θ and converting to PPM and seconds-of-arc.

$$\Delta\theta \text{ (seconds)} = \frac{\Delta A \text{ (PPM)}}{4.85 \sec^2 \theta}$$

The maximum effect of loading on the accuracy of the Resolver Standard may be calculated from the following approximation:

$$\Delta\theta \text{ (seconds)} \approx \pm \left[\text{Real Part of } \left|\frac{Zo \text{ (unbalance)}}{Z_{so}}\right| \times 10^5 - 2\right],$$

where Z_{so} is the stator impedance of the load, with the rotor open, at 0.707 E_s (max).

The Z_o (unbalance) of a Resolver Standard may be approximated at frequencies other than 400 cps, by assuming the j component to be directly proportional to frequency.

The maximum line current from the primary and secondary of a

Resolver Standard may be calculated from the following approximations:

$$I_p \text{ (max)} \approx \frac{1.4NE_s \text{ (max)}}{Z_{so}} \quad \text{at } 45°,\ 135°,\ 225° \text{ and } 315°$$

$$I_s \text{ (max)} \approx \frac{E_s \text{ (max)}}{Z_{so}} \quad \text{at } 0°,\ 90°,\ 180° \text{ and } 270°$$

SECTION III

OPERATION

Maximum accuracy may be obtained from Resolver Standards by observing the following precautions:

1) Never fuse the outputs.

2) Do not purposely apply an unbalanced load.

3) Always use high quality switches, with very low contact resistance, whenever it is necessary to switch the outputs of a Resolver Standard.

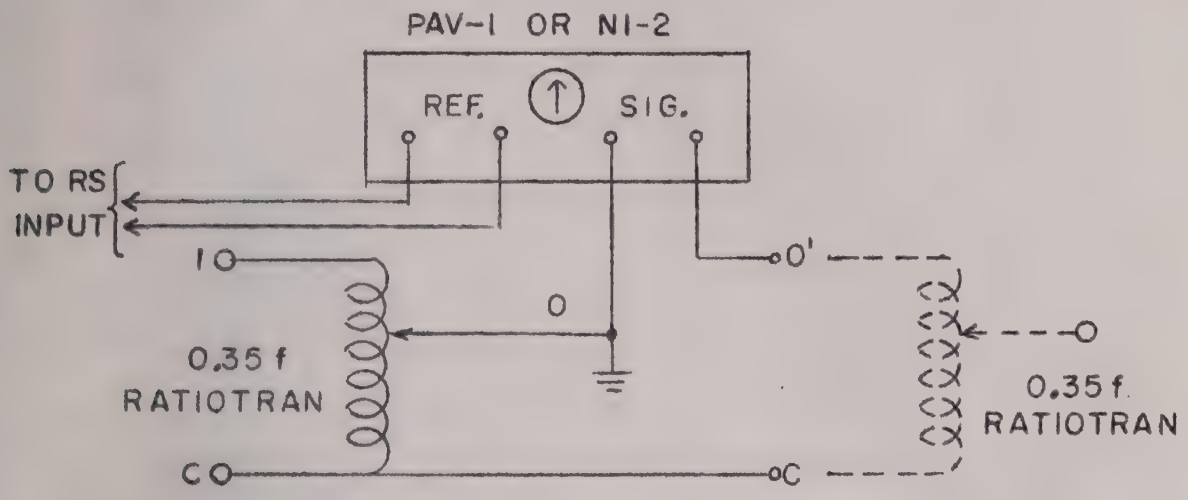
4) Use No. 18 tinned copper wire from the output of the Resolver Standard to the load, and attempt to keep the total lead length from each output terminal approximately the same.

5) Stator current should be limited to approximately one ampere for normal switch contact life and should never exceed two amperes.

SECTION IV

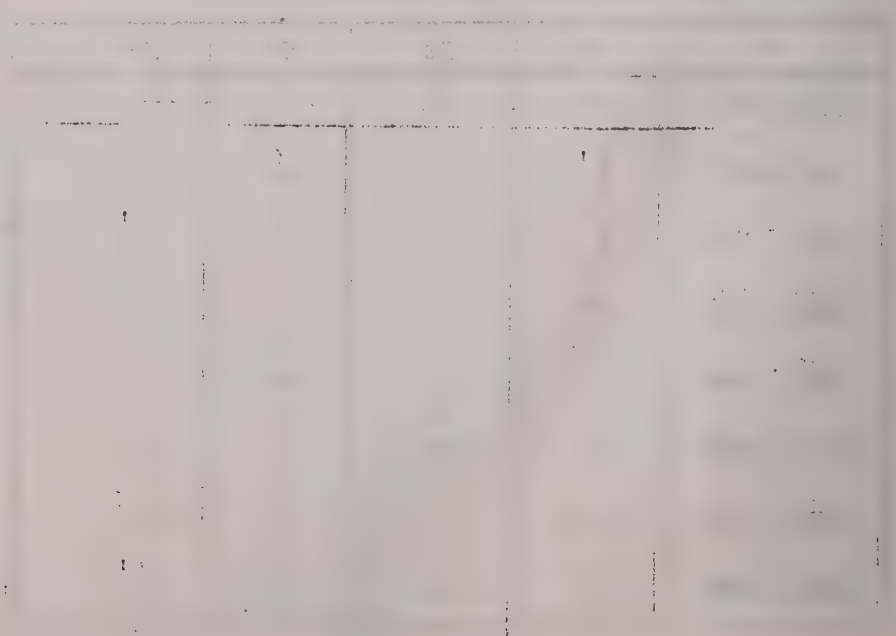
CALIBRATION AND MAINTENANCE

The angular accuracy of a Resolver Standard may be determined by using the following test set-up and tables:



NOTE: For maximum accuracy, a second RatioTran should be used to more closely simulate a balanced load. The effect of this will be maximum at 45°, 135°, 225° and 315°.

θ	S1	S2	S3	S4
0 - 40	0'	C	C	I
45 - 85	I	C	C	0'
90 - 130	I	0'	C	C
135 - 175	0'	I	C	C
180 - 220	C	I	0'	C
225 - 265	C	0'	I	C
270 - 310	C	C	I	0'
315 - 355	C	C	0'	I



10 ± 1 sec

The theoretical ratios, and 2 second tolerances are given below:

θ								$A_{theoretical}$	ΔA (ppm)
0		90		180		270		0.000000	9
5	85	95	175	185	265	275	355	0.087489	9
10	80	100	170	190	260	280	350	0.176327	10
15	75	105	165	195	255	285	345	0.267949	10
20	70	110	160	200	250	290	340	0.363970	11
25	65	115	155	205	245	295	335	0.466308	11
30	60	120	150	210	240	300	330	0.577350	13
35	55	125	145	215	235	305	325	0.700208	14
40	50	130	140	220	230	310	320	0.839100	16
	45		135		225		315	1.000000	19

The effective output impedance unbalance of the Resolver Standard may be readily checked by applying a BALANCED load to the output and measuring A. When testing with an inductive load, it is recommended that non-ferromagnetic inductors (GR type 1482 or equivalent) be used to prevent output voltage variations from changing the inductance of the load.

It isnecessary to connect the RatioTran directly to the output terminals of the Resolver Standard to eliminate errors resulting from voltage drops in interconnecting leads to the load.

The Resolver Standard incorporates the basic design and accuracy characteristics of the standard Gertsch RatioTran and should therefore provide years of maintenance-free service. It is recommended however, that the switch contacts be serviced every three to six months, thus preventing build-up of contact resistance.

In the event that major servicing or re-calibration is required, contact your local Gertsch representative or the factory.

63210